



TECHNICAL COLUMNS

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DTV TRANSITIONS

By RON HRANAC

Barring a last-minute delay by the government, the target date for U.S. full-power TV broadcast stations to discontinue analog transmissions and transmit only digital is Feb. 17. The so-called DTV, or digital television, transition (www.dtv.gov) means that viewers who receive conventional analog TV channels via over-the-air antenna must get a digital-to-analog converter box, or a new digital TV set, or subscribe to cable or satellite. One hopes most U.S. cable operators long ago prepared for the DTV transition, ensuring an uneventful Feb. 17 for existing cable subs.

There will no doubt be a fair number of non-subscribers who, for whatever reason, will be surprised to find that their favorite over-the-air analog TV channels disappear on the transition date. It's not for a lack of trying to educate the public. I've seen numerous instances of local TV stations and cable companies broadcasting information about this for quite some time, and it's been covered extensively on the Web, by newspapers and magazines, radio, and even local consumer electronics stores. Still, there will be some who never got the word. This may well represent an opportunity for cable to pick up a few new subs.

Gremlins

It's also an opportunity for technical performance challenges with long-time gremlins ingress and direct pickup (DPU) interference. Here I'm referring to downstream problems, particularly ingress and DPU from over-the-air digital TV signals. For the technical purists, what I'm referring to as digital - whether an over-the-air broadcaster's 8-VSB (8-level vestigial sideband) or a cable operator's 64- or 256-QAM (quadrature amplitude modulation) digitally modulated signal - actually is analog RF. For a good tutorial on 8-VSB, see the paper by Harris Corp. Broadcast Division's David Sparano at http://download.harris.com/app/public_download.asp?fid=505.

Granted, ingress or DPU interference from over-the-air digital signals isn't new; many operators have experienced this since a handful of TV broadcasters started transmitting digital signals a few years ago. Other types of ingress and DPU in the downstream from sources such as paging transmitters, two-way radios and the like have been with us for a long time. The digital TV signals present some new challenges, largely because of their noise-like nature.

One of my Cisco colleagues, Patrick Duggan, is the inspiration for this month's column. He has been beating the drum about downstream ingress and DPU for a long time and suggests that cable operators consider connecting a spectrum analyzer to a broadband over-the-air antenna to see just what's out there in the frequency range that's used for downstream operation. The DTV transition will move many of the broadcasters' 8-VSB signals to the UHF band, but remember that some will be in the VHF band. Both of these bands cover frequencies that we use in our cable networks.

Some frequencies will shift after the DTV transition - for instance, Denver station KMGH (VHF Ch. 7) has a temporary DTV allocation on UHF Ch. 17 (488-494 MHz), but will return to its original Ch. 7 (174-180 MHz) for permanent DTV operation. Many digital transmitters are currently operating well below their maximum authorized power and will begin transmitting at full power after the transition.



Concerns

There are two points of concern here. One is the noise-like nature of digital signals, and the other is that over-the-air UHF broadcast TV channels don't line up exactly with the 6 MHz channel slots used in North American cable networks. There is a 2 MHz offset between the two! Let's look at the latter first.

KCNC, another Denver-area TV station, broadcasts its analog signal on VHF Ch. 4 (66-72 MHz). KCNC's channel allocation for DTV is UHF Ch. 35, which occupies 596-602 MHz. This particular UHF channel overlaps cable Ch. 86 (594-600 MHz) and 87 (600-606 MHz). Should ingress occur in the local cable network, the digital signal on over-the-air UHF Ch. 35 will potentially interfere with both cable Ch. 86 and 87. The same is true of all North American UHF TV channels; when ingress from one UHF channel occurs, it will likely interfere with two channels on cable because of the 2 MHz offset of the respective UHF and cable channel boundaries. I'm assuming a cable network that uses standard (STD) channelization rather than harmonically related carrier (HRC) channelization.

What about the nature of the interference? When ingress from a noise-like 8-VSB signal occurs, the effect is much like decreasing the carrier-to-noise ratio (CNR) on the cable signals that are being interfered with. If the affected cable signals are analog TV channels, the pictures will be fuzzy or snowy, depending on the actual level of the ingressor relative to the amplitude of the analog TV channels. If the cable signals are QAM channels, the interfering 8-VSB signal, if strong enough, will result in degraded modulation error ratio (MER) and bit error ratio (BER). Remember that many broadcasters will be transmitting their digital signal at higher power levels after the DTV transition than they are today.

Troubleshooting

The noise-like nature of 8-VSB digital signals can make troubleshooting ingress difficult. The noise floor between QAM channels may appear to be elevated, and the relative flatness of the QAM haystacks might be impacted. Here's where the trusty QAM analyzer proves its usefulness, allowing one to check for degraded MER and BER, and possibly also an impaired constellation display.

A clue that ingress from an over-the-air digital signal might be the problem is that only one or two QAM channels are affected, while others in the spectrum appear to be fine. If this sort of interference is suspected, first identify the QAM signals experiencing a problem. Then see if they line up frequency-wise with a local over-the-air digital signal. Don't rule out ingress from non-digital over-the-air signals or headend problems that could affect only a channel or two.

Use the divide-and-conquer technique to locate the problem. Find an area of the plant where things are working properly, and go to the halfway point between there and where the problem is. Keep dividing the plant into smaller and smaller half segments until the location (or locations) of the ingress has been nailed down. Signal leakage monitoring equipment will help, too, because where there's ingress, there is likely leakage.

Remember that there is no direct correlation between the amplitude of a leak and the amplitude of an over-the-air ingressor. Ingress often enters the network via several small amplitude ingress points rather than one big one, although there are exceptions. Use your standard leakage monitoring frequency. Trying to measure a leak on a noise-like QAM signal is next to impossible.

One more thing

One more point to consider. When deciding which cable channels to use to carry critical services such as DOCSIS high-speed Internet and voice over Internet protocol (VoIP) telephony, try to avoid frequencies that will be affected when - not if - ingress from a strong over-the-air signal occurs. This goes back to my colleague Patrick's suggestion to use a spectrum analyzer and antenna to see what's actually present in the over-the-air environment in your system's service area. You can use that information when deciding where to

place or relocate critical channels. Yes, I know that many cable subs think that their favorite channel or service is the most important, but I'd put the DOCSIS/VoIP channel(s) at the top of the list and work down from there.

business swapped our slide rules for scientific calculators and computer-based spreadsheets.

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